

The Economics of the “Trust Game Corporation“

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Abstract

We conceive firm productive activity as being crucially determined by the performance of complex tasks which possess the characteristics of trust games. We show that in trust games with superadditivity the non cooperative solution yielding a suboptimal firm output is the Subgame Perfect Nash Equilibrium (SPNE) of the uniperiodal full information game when i) the trustor has superior stand alone contribution to output and ii) the superadditive component is inferior to the sum of trustee and trustor stand alone contributions to output. We show that, if relational preferences of the two players are sufficiently high, the result is reversed. We also document that the Folk Theorem applies to the infinitely repeated game, even in absence of relational preferences, but the enforceable cooperative equilibrium is not renegotiation proof. We finally show that the cooperative equilibrium is not attainable under single winner tournament schemes and that steeper pay for performance schemes may crowd out information sharing in presence of players preferences for relational goods. Our findings help to explain why firms are reluctant to use pay for performance and tournament incentive schemes and why they invest money to increase the quality of relational goods among employees.

Keywords: Trust Game, Work Incentives, Folk Theorem

JEL classification codes: C72, L29

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1. Introduction

When we conceive workforce as being composed by self interested individuals maximizing consumption under budget constraints in a framework of asymmetric information with moral hazard, it becomes hard to explain why contemporary firms invest money to increase the quality of relationship among workers inside and outside the workplace² and why pay for performance schemes are relatively less and team compensation schemes are relatively more widespread than expected (Baker, Jensen and Murphy, 1988; Baker, Gibbons and Murphy (2002)³. In this paper we try to explain these two apparent puzzles by introducing some changes in the way we conceive firms and by arguing that: i) an essential trait of contemporary firms is that their activity crucially depends on the realisation of complex tasks which require the combination of nonoverlapping skills of several workers and possess the intrinsic characteristics of trust games with superadditivity; ii) individuals have relational preferences (i.e. a taste for quality of relationships) with working colleagues.⁴ By introducing these two elements we are able to show under different versions (uniperiodal, infinitely repeated, with perfect or imperfect information) of our basic “corporate trust game” that lower quality of relational goods, individual pay for performance schemes and (single winner) tournament incentive structures significantly widen the parametric space of “non-cooperative”⁵ equilibria which, in turn, reduce the circulation of knowledge and the interaction of different competencies, yielding suboptimal output for the firm.

Our theoretical framework introduces some elements which are original (in themselves or in the way they are combined in the model) in the literature.

First, it refers to relational preferences which are closely related to, but also represent a slight departure from the more traditional and established field of studies on reciprocity. Fehr and Gächter (2000) show that reciprocity is an important determinant in the enforcement of contracts. They also show that reciprocity may render the provision of explicit incentives inefficient because the incentives may enhance a non-cooperative behaviour.⁶ The hypothesis that reciprocity plays a role in

² One of the biggest Italian banks, Mediobanca, finances weekend skiing holidays to their management with the motivation that it makes the business more fluid. In the U.S., the NRG Systems, a global manufacturer of wind measuring systems, received the 2004 Psychological Association (VPA) thanks to their overall workforce practices and benefits and the emphasis they have placed on a creating a healthy workplace.

³ Empirical evidence shows that profit sharing plans are quite popular. In 1988 20 percent of the U.S. labor force (22 million employees) participated in over 400,000 workplace profit-sharing plans. Furthermore, the number of profit-sharing pension plans has increased by 19,000 per year since 1970.

⁴ To provide empirical evidence on this second point we also report in the Appendix econometric findings showing how the time spent with working colleagues outside the jobplace has positive effects on individual’s happiness.

⁵ Note that we define as *cooperative solution* in the paper the equilibrium given by the (share, not abuse) pair of strategies (see Figure 1) and as *non cooperative solutions* the two equilibria which do not imply the joint work of the two players. Hence, the term cooperative is not referred to the structure of the game (and to the coordination/non-coordination of players’ decisions) but to the characteristics of its equilibrium.

⁶ The employment relationship may be characterized by complete or incomplete contracts. Under complete contracts a cooperative job attitude would be superfluous because all relevant actions would be described and enforceable, while, under incomplete contracts, workers have a high degree of discretion over effort levels since no explicit performance incentives are defined. In this case reciprocity can be very important in the labor process since, if a substantial fraction of the work force is motivated by reciprocity considerations, employers can affect the degree of cooperation by varying the generosity of the compensation package.

determining effort for a significant part of workers has been successfully tested in several laboratory experiments (Fehr, Gächter and Kirchsteiger, 1997; Fehr and Gächter, 2000; Bewley, 1995)⁷. The concept of relational goods (Ash, 2000) that we introduce is slightly different from that of reciprocity and may help to shed light on the interaction between material incentives and productivity. According to Uhlaner (1989) and Gui (2000) relational goods are local public goods that need i) to be jointly co-produced and ii) to be simultaneously co-consumed to be enjoyed⁸. While a sufficient condition for reciprocity is the feeling of the obligation to reciprocate what has been received by a counterpart and, therefore, a general sense of justice, relational values are more related to the pleasure that the individuals have in spending time with other individuals. In support of the relational good approach and of its importance in the job place. Frey (1997) argues that more personal relationships imply recognition, trust and loyalty which support intrinsic motivation. Hence, our point is that the focus on the dynamics of relational goods does not exactly coincide, but is at the root of the widely analyzed phenomena of trust, reciprocity or intrinsic motivation, since the latter tends not only to be based on abstract principles or on a “Kantian” sense of duty, but also on the quality of relationships.

In our paper an original virtuous relationship between relational goods and productivity is carefully explained. *In the trust game framework the relational good increases the penalty for a noncooperative attitude (represented by the loss of the accumulated relational stock) and therefore reduces the parametric space of noncooperative equilibria which are suboptimal on the productive point of view.* We therefore identify a positive nexus which goes from the quality of workers relationships to the willingness to share information and cooperate and from the willingness to cooperate to firm productivity.

A second novelty of the paper is that it applies the standard trust game approach to the literature of the organisation of the firm.⁹ This is an important innovation in the way we conceive a firm since, when we depart from the assembly line perspective and move toward a firm in which workers skills are fundamental to create value and innovate products and processes, corporate activity becomes more complex and

⁷ A crucial question in this field is to understand how material incentives based on performance interact with reciprocity. Following Fehr and Gächter (2000) two main aspects have to be taken into account: i) reciprocity increases the extra effort determined by material incentives and ii) explicit incentives may cause a hostile atmosphere of threat and distrust which reduces any reciprocity-based extra effort.

⁸ Standard microeconomic foundations of agents utility usually neglect the fact that the latter does not depend only on the amount of consumed goods but also, at least, on the relational context in which material goods are consumed (eating pizza alone is not the same as eating a pizza with friends or with the love partner). Going back to the history of economic thought, one of the nicest and deepest interpretations of the link between social capital ties and happiness is provided by Adam Smith (1759) with its well known theory of fellow feelings. In the *Theory of Moral Sentiments* Smith argues that the effect of relational goods on happiness is increasing in i) the amount of time and experiences that two individuals have lived together and have shared in the past, and ii) their common consent, with the former significantly affecting the latter.

⁹ There is ample experimental literature showing that predictions from standard noncooperative game theory do not apply to large part of two-person trust games (McCabe et al. 2003; Berg, et al., 1995; McCabe, et al., 1998). There is no literature, to our knowledge, studying consequences of trust games among co-workers.

requires the sharing and interaction of different nonoverlapping competencies and information.¹⁰

Third, it fills a gap in the theory of the firm introducing additional elements which help to reconcile theoretical models with the above mentioned empirical evidence on the (lower than expected) diffusion of individual pay for performance schemes¹¹ and the (higher than expected) diffusion of profit sharing or team compensation schemes, especially when we depart from employees with repetitive tasks or working in assembly lines (Frey, 1977; Baker, Jensen and Murphy, 1998; Baker, Gibbons and Murphy, 2002). This evidence is difficult to reconcile with the standard theory of the firm and with the traditional argument in the literature that tournament schemes may raise performance when the disciplining effect, as it is conventionally assumed, is larger than the crowding-out effect of intrinsic motivation (Lazear and Rosen, 1981). Some of the rationales advanced to explain this puzzle come from psychologists and behaviorists. Deci and Ryan (1985) identifies a trade-off between monetary compensation and “intrinsic rewards”.¹² Slater (1980) argues that money as a motivator has negative effects on product quality. Kohn (1988) argues that monetary rewards “encourage people to focus narrowly on a task, to do it as quickly as possible, and to take few risks.” Other potential explanations for this puzzle are horizontal equity concerns, and imperfect performance measurement.¹³

In our model we show that the conception of firm activity as a series of trust games in which different tasks and information from various individuals are combined may be, under reasonable parametric assumptions, a sufficient condition for determining the relative inconvenience of single winner tournaments schemes even without considering the crowding out effect on intrinsic motivations and, therefore, purely on extrinsic motivation grounds. We also show that the presence of relational goods introduces a specific crowding out effect of pay for performance schemes on cooperation.

The paper derives the above mentioned considerations from a theoretical model and is divided into six sections (introduction and conclusions included). In the second section we examine the uniperiodal and the infinitely repeated full information games (with and without the presence of relational goods), when the two players own the company. In the third section we look for Bayesian equilibria under the assumption of uncertainty on skills and relational attitudes of the two players. In the fourth section we find equilibria for the corporate trust game when players are firm

¹⁰ Thompson and Wallace (1996) argue that, with the development of lean production and other forms of work organization under advanced manufacturing, teamworking has emerged as a central focus of redesigning production. Katz and Rosemberg (2004) argue that “that the productivity of an organization crucially depends on cooperation between workers” and make reference to the importance of altruistic and cooperative attributes in workers emphasized by the organizational theory (see, for example, Smith et al. (1983), Organ (1988), Organ and Ryan (1995), McNeely and Meglino (1994), Penner et al, (1997) and Podsakoff and Mackenzie (1993)).

¹¹ Baker et al. (1998) argue that “when measures of individual performance are available, it always seems better to tie pay to individual performance rather than to overall firm performance.”

¹² The crowding out hypothesis relies on the assumption that, if workers are already intrinsically motivated, an extrinsic reward overmotivates them and therefore they rationally react by reducing the motivation which is under their control (i.e. the intrinsic motivation).

¹³ Among contributions on the role of intrinsic motivation on the behaviour of economic agents see, among others, Frey (1997) and Kreps (1997).

employees and pay for performance and tournament schemes are introduced. In the fifth section we briefly illustrate the optimal corporate policy for trust game corporations.

2. The basic trust game when the two players own the company

We conveniently model the productive activity of a firm as being made by the performance of complex tasks¹⁴ which require the contribution of knowledge, inventive skills and ideas of workers with different human capital endowments.

In our specific case we assume that any complex task consists of a trust game between two firm employees, players A and B, endowed with personal skills (stand alone contributions to final output) that we term, respectively, as $h_a \in R^+$ and $h_b \in R^+$. The trust game is a sequential game in which one of the two players (player A, the trustor) may decide whether sharing or not skills with the other player. In the second stage of the game the second player (player B, the trustee) may decide to cooperate or abuse.

We assume in the model that sharing ideas, projects, intuitions creates a positive externality - that we introduce in the model as a superadditive component ($e \in [0,.]$) - generated by the dialogical process of jointly performing the task and by the initial knowledge sharing¹⁵.

Summing up the set of strategies available to the two players, player A (the trustor) may decide to share (*s* strategy) or not to share (*ns* strategy) his initial ideas to the trustee who, in turn, may decide to abuse (*a* strategy) or not (*na* strategy). If the trustee decides to abuse he will join his ideas with those of the trustor and present everything as his own work, while, if he decides to share, the two players will interact and produce as additional contribution to the output a superadditive component (*e*) stemming from the integration of players perspectives and new ideas arising from the interaction. We assume in this case that the final output will be split between the two players.

Under these assumptions the set of payoffs (player A, player B and firm output) are: $\{0 \mid h_a < h_b, h_a \mid h_a > h_b, 0 \mid h_a > h_b, h_b \mid h_b > h_a, \text{Max}(h_a, h_b)\}$ ¹⁶ if player A does not share;

$\{0, h_a + h_b, h_a + h_b\}$ ¹⁷ if player A shares but player B chooses to abuse;

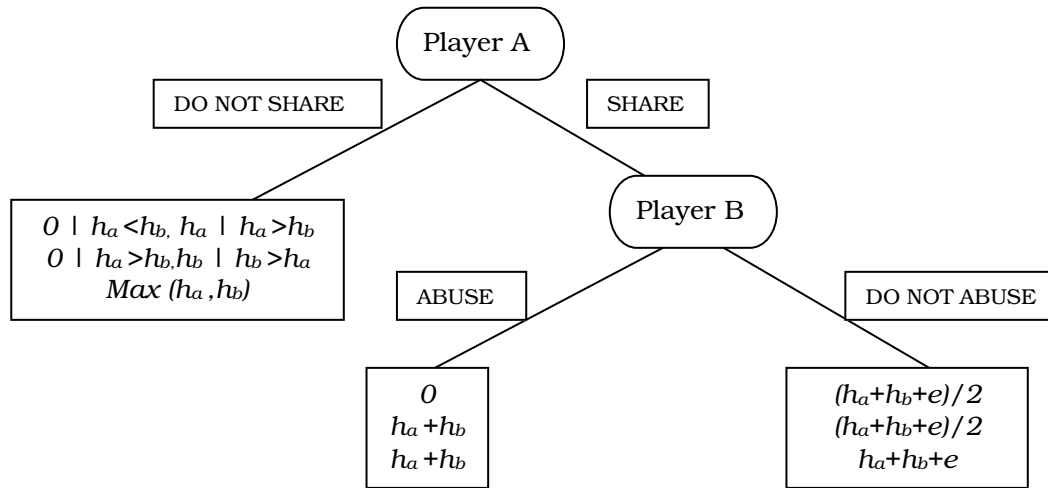
¹⁴ Consider for instance a blueprint in which different contributor's skills are production inputs related by some complementarities. Or the definition of a corporate strategy which requires participants from different firm divisions to share competences and skills. The same scheme could be applied in different (non corporate) fields of activity considering, for instance, a co-authored academic working paper to which different researchers contribute with their specialised skills.

¹⁵ Our point here is that dialogue, interaction and information sharing is indispensable to the act of cognition which improves productive knowledge. In particular, superadditivity implies that i) part of productive skills may be acquired only by integrating experiences of different people ii) learning is a process which can be enhanced by explaining and confronting one's own knowledge with that of a workmate. On point i) consider the well known story about the blind men and the elephant. The blind men ask to a wise man to explain them what is an elephant. The wise man suggests to go and touch it. Each blind man can get only part of the truth by touching a part of the body of the elephant. The group of blind men acquires reasonable knowledge of the phenomenon under investigation (the elephant) only when the partial and insufficient information collected by each individual is pooled.

¹⁶ The assumption here is that some authority external to the two players will pick up and prize the best individual "blueprint". We may imagine that, in a competition for a project, the two players, when not agreeing to cooperate, decide to participate separately to the competition.

$\{(h_a+h_b+e)/2, (h_a+h_b+e)/2, h_a+h_b+e\}$, if player A shares and player B cooperates. The game is represented in the extensive form in Figure 1.

FIGURE 1 THE UNIPERIODAL FULL INFORMATION GAME



The analysis of the uniperiodal trust game leads us to formulate the following proposition

Proposition 1. The “non sharing” solution yielding a suboptimal firm output is the SPNE of the uniperiodal full information game when i) the trustor has higher stand alone contribution to output than the trustee and ii) the superadditive component is inferior to the sum of trustee and trustor stand alone contributions.

When $h_a > h_b$, player’s A payoff is h_a if he does cooperate and 0 if he decides to cooperate but player B abuses, as he will do when $h_a + h_b > [(h_a + h_b + e)/2]$, or, $e < h_a + h_b$. Hence, if $h_a > h_b$, the non sharing solution is the SPNE of the uniperiodal full information game.¹⁸

Consider that the SPNE yields a firm output - $Max (h_a, h_b)$ – which is lower than the one achievable under cooperation $(h_a + h_b + e)$, and even lower than that obtainable under the (share, abuse) pair of strategies¹⁹. The loss of social surplus (and of firm productive potential) therefore amounts to $h_a + h_b + e - Max (h_a, h_b)$. If, on the contrary, $h_b > h_a$, player A is indifferent between the two available strategies (“share” and “do not share”), since the payoff that he will receive is the same in both cases. In such case the SPNE equilibrium can alternatively be represented by the following strategy

¹⁷ The assumption here is that the two players’ competencies and skills do not overlap. If they do, the total output of player B in the (s,a) solution and the one shared by the two players in the (s,na) solution should be the non overlapping parts of the sum of the two stand alone contributions. A second assumption is that the trustee has sufficient skills to be able to manage the contribution provided by the trustor and therefore to abuse of it.

¹⁸ Two consequences of the SPNE of the game which are intuitively reasonable are that: i) the trustor’s propensity to share crucially depends on the knowledge that his stand alone contribution to output is lower than that of the trustee; ii) the likelihood of the occurrence of the (the share, not abuse) solution is higher when the two players stand alone contributions are small with respect to the output they can generate by applying together to the problem (i.e. complex rules of the task that need to be interpreted with the skills of both).

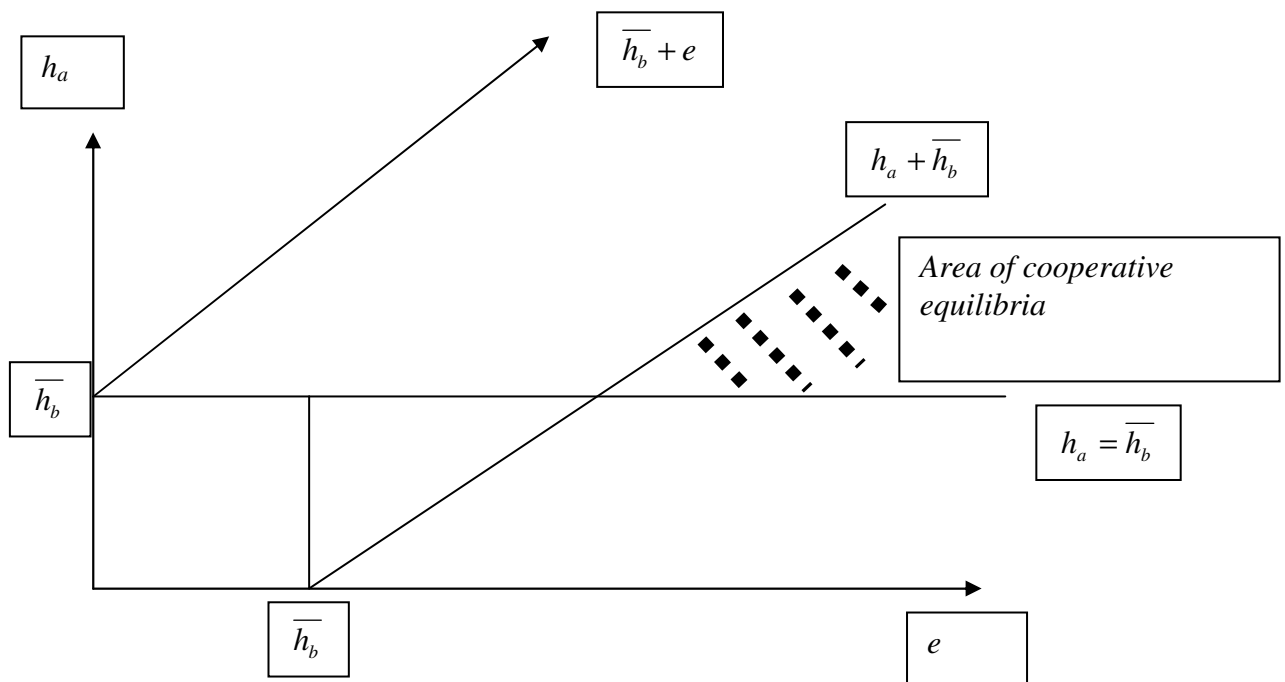
¹⁹ We reasonably assume that, when player B abuses, he exploits player A information for his own project before starting the cooperative process of jointly performing the task and therefore $e=0$.

pairs (ns,.) or (s,a), yielding again a suboptimal firm output with a social loss respectively equal to $(h_a+h_b+e) - \text{Max}(h_a, h_b)$ or e^{20} . □

To sum up, the full information uniperiodal game shows that when the trustor's stand alone contribution is higher, the subgame perfect equilibrium is the non sharing solution and the firm output is inferior to its maximum potential. Under the alternative assumption on the relative human capital endowments of the two players we have two possible solutions. Both of them do not imply information sharing and still yield a suboptimal firm output.

A graphic representation of the cooperation area is provided in Figure 2 in which the superadditivity component is on the horizontal axis, the trustor stand alone contribution is on the vertical axis and the trustee stand alone contribution is fixed. The area of information sharing equilibria is the one, below the fixed level of trustee stand alone contribution, in which $e > h_a + h_b$

FIGURE 2. A GRAPHICAL DESCRIPTION OF PLAYERS' PAYOFFS IN THE UNIPERIODAL FULL INFORMATION GAME (FOR A GIVEN \bar{h}_b LEVEL)



2.1 The basic trust game when players own the company with relational goods

In the basic version of the model presented in section 2 we did not take into account the role of relational goods. As already mentioned in the introduction, more personal relationships imply recognition, trust and loyalty which support intrinsic motivation (Frey, 1997). Relational preferences (and the enjoyment of relational goods) are

²⁰ Note that the trustor would strictly prefer the (ns,.) solution if we add some forms of inequity aversion to the model.

therefore one of the fundamental inputs of trust and reciprocity. Their introduction into players preferences needs to be motivated. In the Appendix we provide empirical evidence which supports our choice showing that, in a sample of more than 100,000 individuals from 82 countries drawn from the World Value Survey database, the time spent with job friends outside the workplace significantly increases the probability of declaring oneself very happy, net of the effect of standard controls traditionally used in the empirical happiness literature.

In this section we assume that the two players have a stock of accumulated relational goods equal to F which depends on the number of times they have cooperated in the past and may jointly produce a relational good (f) with their decision to cooperate. The solution of the uniperiodal game with relational goods leads us to formulate the following proposition

Proposition 2. In the uniperiodal full information game there exists a threshold value of the relational good in the trustee's utility function (f^) which triggers the switch from the non cooperative to the cooperative (share, not abuse) equilibrium.*

In presence of relational goods the payoff set (player A and player B payoffs and firm output) becomes:

$\{ F \mid h_a < h_b, F+h_a \mid h_a > h_b ; F \mid h_b < h_a, F+h_b \mid h_b > h_a ; \text{Max}(h_a, h_b) \}$ if player A does not share; $\{0, h_a+h_b, h_a+h_b\}$, if player A shares but player B chooses to abuse; $\{(h_a+h_b+e)/2+F+f, (h_a+h_b+e)/2+F+f, h_a+h_b+e\}$, if player A shares and player B does not abuse (Figure 3).

If $h_a > h_b$, the subgame perfect equilibrium of the full information uniperiodal game is $(ns, .)$ when $(F+h_a) > 0$. This condition is always respected as far as $F > 0$, or when the players have a strictly positive stock of relational goods.²¹ On the other hand, if $h_b > h_a$, player B chooses to abuse when $h_a+h_b > [(h_a+h_b+e)/2]+F+f$ or $h_a+h_b > e+2(F+f)$ (which represents the new *abuse condition* in presence of value of relational goods). Again, the non cooperative solution yields a firm output, $\text{Max}(h_a, h_b)$, which is lower than h_a+h_b+e (that is firm output under the (s, na) equilibrium) and lower than that obtained under the (s, a) solution. Hence, given the new abuse condition we may identify a threshold f^* of the value of the relational goods for the trustee above which the (share, not abuse) couple of strategies becomes the SPNE of the single period full information game. Such threshold is equal to $f^* = (h_a+h_b-e)/2 - F$. \square

By examining now the abuse condition we observe that the incentive to abuse is reduced because of the potential loss of the stock of relational goods and the missed production of new relational goods in case of non cooperation (see Figure 3). The introduction of relational goods therefore identifies a virtuous circle among quality of relationship, decision to cooperate (which further increases the quality of relationship) and firm productivity, or among relational goods, social capital (under the form of trust) and firm productivity (see Figure 4).

²¹ Our underlying assumption is that the accumulated stock of relational goods between the two players may be lost only when one of the two decides to abuse and not when he decides not to share. Under this condition, in presence of relational goods, the trustor will not be indifferent anymore between sharing or not when $h_a < h_b$ and the no abuse condition is not met since, by sharing, he will "induce into temptation" the other part with the risk of losing the accumulated stock of relational goods. Hence, if $F > 0$ and $h_a < h_b$, the $(ns, .)$ is strictly preferred. Under this case the firm output is always suboptimal but may be inferior in presence of relational goods.

FIGURE 3 THE UNIPERIODAL FULL INFORMATION GAME WITH RELATIONAL GOODS

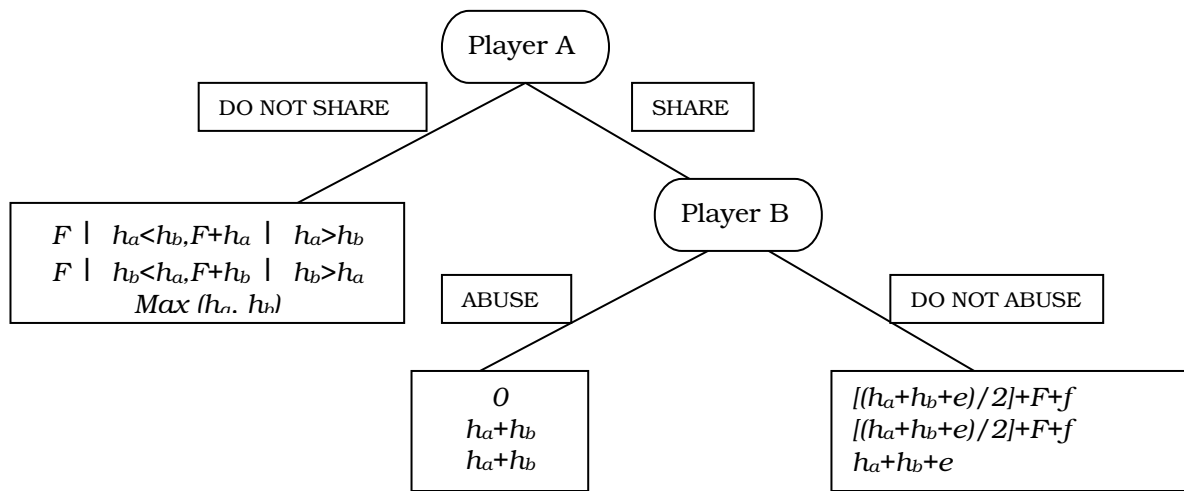
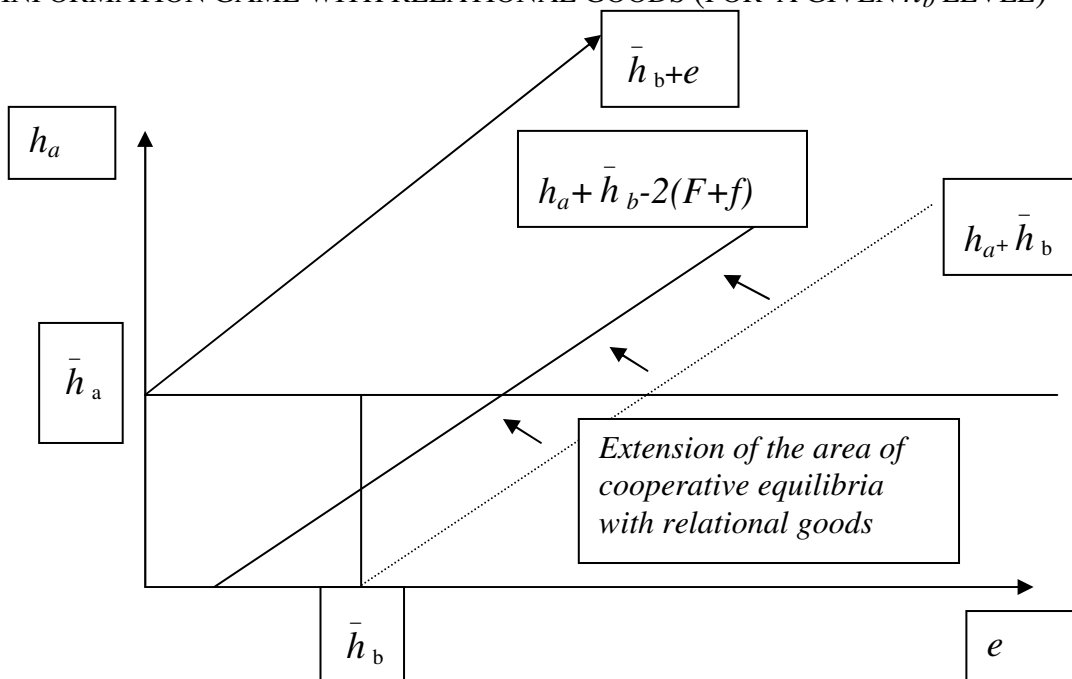


FIGURE 4. A GRAPHICAL DESCRIPTION OF PLAYERS' PAYOFFS IN THE UNIPERIODAL FULL INFORMATION GAME WITH RELATIONAL GOODS (FOR A GIVEN h_b LEVEL)



3.1 The two period full information trust game when the players own the firm.

In order to find a stable subgame perfect equilibrium in a multiperiodal game, it is important to define strategies and calculate payoffs in the stage occurring after a noncooperative equilibrium. We assume here a “tit-for-tat” strategy in which the

trustor's threat is not to share in the second period if he is abused in the first. The analysis of the two period full information game leads us to formulate the following proposition.

Proposition 3. In the two period full information game the no abuse condition is less binding, but the trustor's threat is not renegotiation proof.

Let us consider for simplicity the following two period version of the corporate trust game. At the beginning of the first period, player A has to decide whether to share or not. Player B, in turn, must decide whether to abuse or not, as in the previous section. In the second period game, player A can threaten to punish player B in case he abuses in the first period. The punishment is represented by the refusal to share in the second period game.

If player A decides not to share the idea, the payoff will be, as in the previous case, $h_a(1 + \delta)$ if $h_a > h_b$, while it will be $h_b(1 + \delta)$, if $h_b > h_a$, where δ is the inverse of the subjective discount rate or the standard measure of players' "patience"²². If, on the other hand, player B does not abuse, the payoff of each player will be $(h_a + h_b + e)/2(1 + \delta)$. If player A shares and player B abuses decides to abuse, player A payoff will be zero, if $h_b > h_a$, or δh_a , if $h_a > h_b$, while player B payoff will depend on the difference between the skills of two players. If $h_a > h_b$, player B payoff is the sum of players' stand alone contributions, $h_a + h_b$, given that there is not any added value to be discounted in the second period, (player A will decide not to share the idea in the second stage if player B abused in the first), while, if $h_b > h_a$, we must add to $h_a + h_b$ player B stand alone contribution multiplied by the discount rate. Under the $h_a > h_b$ hypothesis, the no abuse condition in the first period is the following $e > (h_a + h_b)[(1 - \delta)/(1 + \delta)]$, or, $\delta > (h_a + h_b - e)/(h_a + h_b + e)$. The condition may be met for reasonable values of $\delta \in [0, 1]$, (e) and players' stand alone contributions. More specifically, with minimum patience, ($\delta = 0$), we fall back into the no abuse condition of the uniperiodal game ($e > h_a + h_b$) while, with maximum patience ($\delta = 1$), the no abuse condition is much easier to be respected as it just requires a nonzero superadditive component ($e > 0$).

If, on the contrary, $h_b > h_a$ ²³ the no abuse condition is $e > h_b + (h_a)[(1 - \delta)/(1 + \delta)]$.

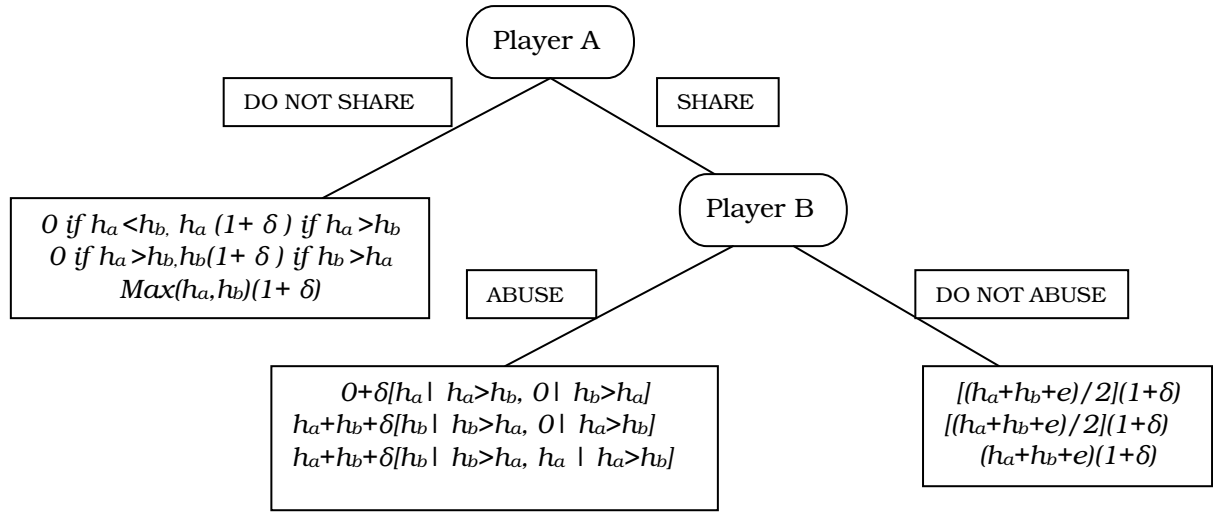
Again, with minimum patience ($\delta = 0$), we fall back into the no abuse condition of the uniperiodal game $e > h_a + h_b$ while, with maximum patience ($\delta = 1$), the no abuse condition reduces to ($e > h_b$)²⁴ (see Figure 5).

²² Consider that higher values of δ can also be viewed as a measure of the reduced distance between two consecutive stages of the game.

²³ Remember that, also in this case, when the no abuse condition is not met, player A is still indifferent whether to share or not and may still decide to share. We therefore have two SPNE, (ns,.) and (s,a), both yielding suboptimal output for the firm. The output loss is respectively $(h_a + h_b + e) - h_b$ and $(h_a + h_b + e) - (h_b + h_a)$ under the assumption that player A reiterates the same strategy in the two periods.

²⁴ In graphical terms in figure 5 with trustee maximum patience ($\delta = 1$) the two period game no abuse area would be represented by all the positive quadrant, under the $h_a > h_b$ hypothesis, and by the area at the right of the $e = h_b$ vertical line, under the $h_a < h_b$ hypothesis.

FIGURE 5 THE TWO PERIOD FULL INFORMATION GAME



Even if the no abuse condition is respected this solution is not renegotiation proof. In fact, the punishment strategy costs in the second period to the trustor $(h_a+h_b+e)/2$, if $h_b > h_a$, and $(h_a+h_b+e)/2 - h_a$, if $h_b < h_a$. Hence, the trustee may propose, after abusing in the first period, a preliminary side payment - in case the trustor decides to share - of ε , when $h_b > h_a$, or $h_a + \varepsilon$, when $h_a > h_b$. The trustor should strictly prefer the new proposal which may be repeated an infinite number of times after any abuse by the trustee. Hence, the new no abuse condition will be $e > h_a + h_b - \delta\varepsilon/(1+\delta)$, when $h_a < h_b$, and $e > h_a + h_b - \delta(h_a + \varepsilon)/(1+\delta)$, when $h_a > h_b$. Renegotiation therefore reduces significantly the parametric space of the no abuse condition. \square

2.3 The two period full information trust game with relational goods when players own the firm.

In the two period trust game with relational goods, as in the one period game, the abuse strategy of player A determines the “destruction” of the accumulated relational stock F . In such case, player B payoff is $h_a + h_b + \delta[h_b | h_b > h_a, 0 | h_a > h_b]$ (Figure 6). On the other hand, if player B does not abuse, each player obtains the following payoff

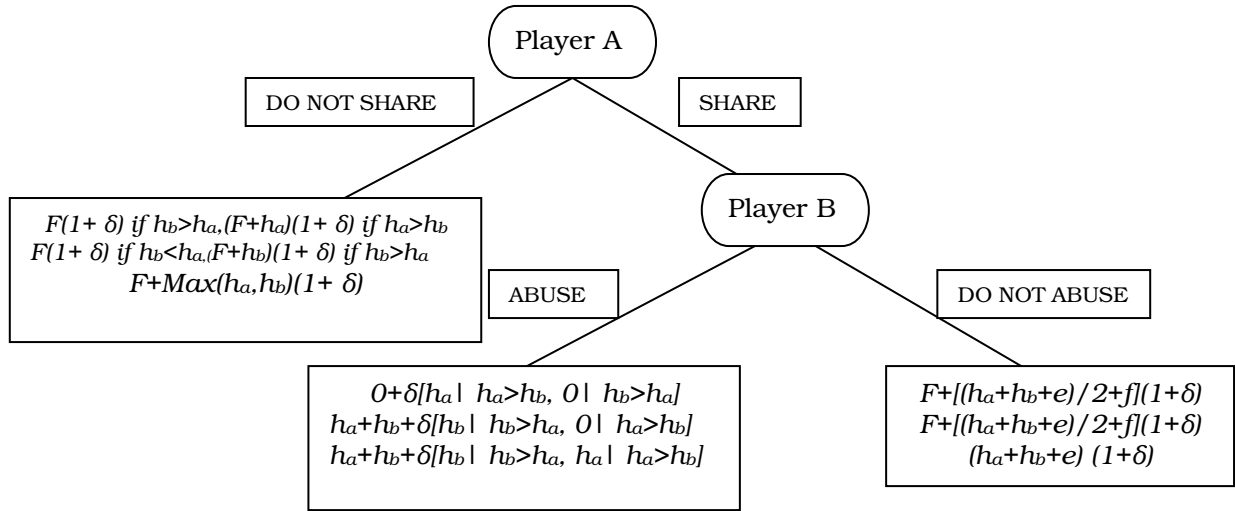
$$F[(h_a + h_b + e)/2 + f](1 + \delta).$$

Hence, the no-abuse condition in the first period is $F + [(h_a + h_b + e)/2 + f](1 + \delta) > h_a + h_b + \delta[h_b | h_b > h_a, 0 | h_a > h_b]$. If $h_a > h_b$, the no abuse condition becomes

$$F + [(h_a + h_b + e)/2 + f](1 + \delta) > h_a + h_b \text{ or } e > (h_a + h_b - F)[(1 - \delta)/(1 + \delta)] - 2f.$$

If we compare it with the analogous solution in 2.2 (when $f = F = 0$) we easily observe that the presence of the relational good arguments makes the no abuse condition less stringent and widens the parametric space of cooperative equilibria. Consider now the case in which $h_b > h_a$. The no-abuse condition is $F + [(h_a + h_b + e)/2 + f](1 + \delta) > h_a + h_b + \delta h_b$ or $e > (h_a + h_b - F)[(1 - \delta)/(1 + \delta)] - 2f + 2[\delta/(1 + \delta)]h_b$. In such case the no abuse condition is more difficult to be met even in presence of preference for relational goods.

FIGURE 6 THE TWO PERIOD FULL INFORMATION GAME WITH RELATIONAL GOODS



As in the single period game the presence of relational goods in the two period full information games enlarges the parametric space in which cooperative (no abuse) equilibria are attained.

As in section 2.2, even if the no abuse condition is respected this solution is not renegotiation proof. In fact, the punishment strategy costs in the second period to the trustor is $f+(h_a+h_b+e)/2$, if $h_b > h_a$, and $f+(h_a+h_b+e)/2 - h_a$, if $h_b < h_a$. As a consequence, the trustee may propose, after abusing in the first period, a preliminary side payment - in case the trustor decides to share - of ε , when $h_b > h_a$, or $(h_a+\varepsilon)$, when $h_a > h_b$. Hence, the new no abuse condition will be $e > h_a+h_b-F-2f-\delta\varepsilon/(1+\delta)$, when $h_a < h_b$, and $e > h_a+h_b-F-2f-\delta(h_a+\varepsilon)/(1+\delta)$, when $h_a > h_b$. As in the case of section 2.2, the renegotiation significantly reduces significantly the parametric space of the no abuse condition.

2.4 The infinitely repeated game

The analysis of the infinitely repeated version of the game in presence of relational goods leads us to formulate the following proposition.

Proposition 4. In the full information infinitely repeated trust game, the (share, no abuse) equilibrium may be applied without the need of relational goods for reasonable discount rates, but it may never hold, under given parametric conditions, when the trustee stand alone contribution is higher than that of the trustor. Even when the (share, not abuse) equilibrium applies, it is however based on a trustor threat which is not renegotiation proof.

The Folk Theorem applies to the infinitely repeated game if there exists a $\delta \in [0,1]$ such that the (share, not abuse) equilibrium is enforceable. By applying it to our model we get $(1-\tilde{\delta})(h_a+h_b) = (h_a+h_b+e)/2$, if $h_a > h_b$, and $(1-\tilde{\delta})(h_a+h_b) + \tilde{\delta}h_b = (h_a+h_b+e)/2$, if $h_b > h_a$.

In both cases we may find a $\tilde{\delta} \leq 1$ such that the equality is met.

If $h_a > h_b$, $\tilde{\delta} = 1/2 - e/[2(h_a + h_b)]$ which is below 1 for reasonable parametric values. Hence, the minimum trustee patience' required to have a cooperation equilibrium is negatively related to the ratio between the superadditive component and the sum of the two players' stand alone contributions. The intuition is that the superadditive component is what players lose when they decide not to cooperate. If the loss is high, a cooperative equilibrium can be enforced also when the trustee has limited patience.

On the other hand, if $h_b > h_a$ ²⁵, $\tilde{\delta} = 1/2 + (1/2)(h_b/h_a) - e/h_a$. Under reasonable parametric conditions - and, more specifically, when $[(h_b - h_a)/2] < e$ - we get $\tilde{\delta} > 1$ and the cooperative equilibrium may not be enforced.

The renegotiation argument applies also here. Consider that the punishment strategy costs any period to the trustor $(h_a + h_b + e)/2$, if $h_b > h_a$, and $((h_a + h_b + e)/2) - h_a$ if $h_b < h_a$. Hence, the trustee may propose, after abusing in the first period, a preliminary side payment of ε , when $h_b > h_a$, or $h_a + \varepsilon$, when $h_a > h_b$, conditional to the trustor's commitment to share in the following period. The trustor should strictly prefer the new proposal which may be repeated an infinite number of times after any abuse by the trustee. Hence, we get $(1 - \tilde{\delta})(h_a + h_b) + \tilde{\delta}(h_a + h_b - \varepsilon) = (h_a + h_b + e)/2$, if $h_a < h_b$, and $(1 - \tilde{\delta})(h_a + h_b) + \tilde{\delta}(h_b + \varepsilon) = (h_a + h_b + e)/2$, if $h_b < h_a$. It is easy to check that, in both cases, and especially when $h_a < h_b$, $\tilde{\delta} > 1$ under reasonable parametric conditions.

Notice that the Folk Theorem condition under $h_a > h_b$ implies that the minimum trustee patience required to have a cooperation equilibrium is negatively related to the ratio between the superadditive component and the sum of the two players stand alone contributions. The intuition is that the superadditive component is what players lose when they decide not to cooperate. If the loss is high, a cooperative equilibrium can be enforced also when the trustee has limited patience. When, on the contrary, $h_b > h_a$, the Folk Theorem condition implies that the minimum trustee patience required to have a cooperation equilibrium is higher and depends positively from the trustee stand alone contribution and negatively from the superadditive component and trustor stand alone contribution which are part of the punishment in case of abuse.

2.5 The trust game with imperfect information

We have assumed so far that players are perfectly informed about game payoff and each other skills. More realistically, corporate trust game players have to deal with an incomplete information framework. We reasonably argue that informational asymmetry in the corporate trust game is related to two different aspects: i) the relational attitude of the other player, that is, the presence in his utility function of a positive argument related to the cooperation with his colleague; ii) the stand alone contribution to output of the other player. In this version of the model we deal with the first type of imperfect information. The assumption of imperfect knowledge about the counterpart relational attitudes obviously implies that the two players have not

²⁵ The argument developed in footnote 21 with regard to the two period game applies also here with the proper changes in the firm output loss.

enjoyed cooperation before and therefore $F=0$. More specifically, we assume that each player attaches a probability $p \in [0,1]$ to the likelihood that his counterpart gives a value f to the relational good produced by the cooperative working activity (see Figure 7). The modified framework of the game leads us to formulate the following proposition.

Proposition 5. The trustor imperfect information about the trustee's relational preferences raises the threshold value of the relational good required to ensure the (share, not abuse) equilibrium

When each player attaches a probability p to the likelihood that his counterpart gives a value f to the relational good produced by the cooperative working activity the no abuse condition becomes

$$2pf+e > h_a+h_b.$$

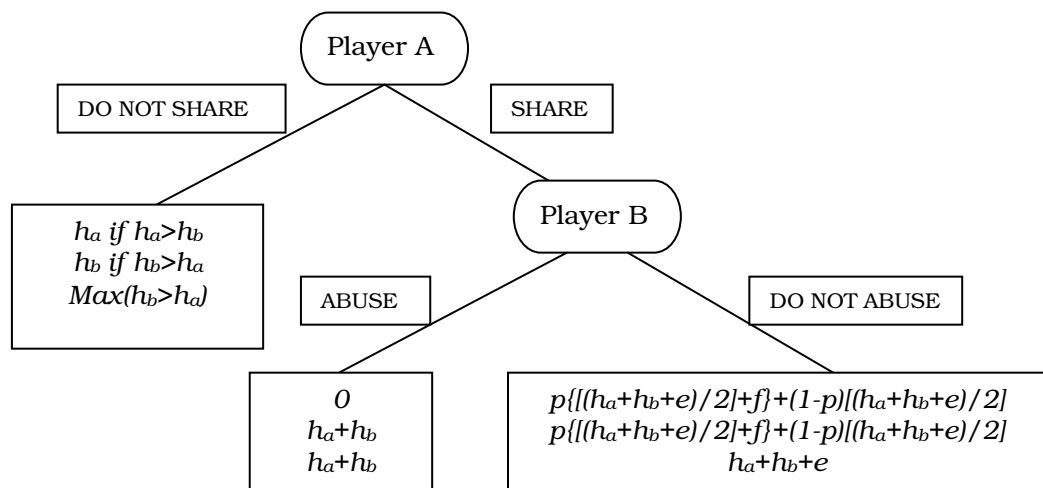
Hence, the Bayesian NE of the game is: i) (ns,.) if $p[e+2f]+(1-p) e < h_a+h_b$ and $h_a > h_b$; ii) (ns,.) or (s, a) if $p[e+2f]+(1-p) e < h_a+h_b$ and $h_b > h_a$, iii) (s,na) if $p[e+2f]+(1-p) e > h_a+h_b$.

Considering the three different solutions, we assume that a “threshold probability value” p^* exists, such that, when $p > p^*$, the (share, not abuse) pair of strategies becomes the NE of the game. We can obtain p^* as $p^* = (h_a+h_b+e)/2f$.

For $p^* < 1$ we need $f^* > [(h_a+h_b+e)/2]/p^*$. This implies a “threshold value of the relational good under uncertainty” which is higher than its certainty correspondent (in which $p=1$). □

This result shows that the no abuse condition with incomplete information is respected only if the relational good produced by the interaction of the two players is big enough to compensate the cost of the uncertainty about the counterpart stand.

FIGURE 7 THE UNIPERIODAL FULL INFORMATION GAME UNDER IMPERFECT INFORMATION ON TRUSTEE RELATIONAL PREFERENCES



Let us consider a second case of imperfect information related to the counterpart stand alone contribution. We assume here that player A assigns a subjective probability p_1 ($p_1 \in [0,1]$) to the $h_a > h_b$ hypothesis, while player B a subjective

probability p_2 ($p_2 \in [0, 1]$) to the alternative $h_b > h_a$ hypothesis (see Figure 8). We also assume that each player does not know the guess of the other.

The inspection of the corporate trust game which incorporates these new assumptions leads us to formulate the following proposition

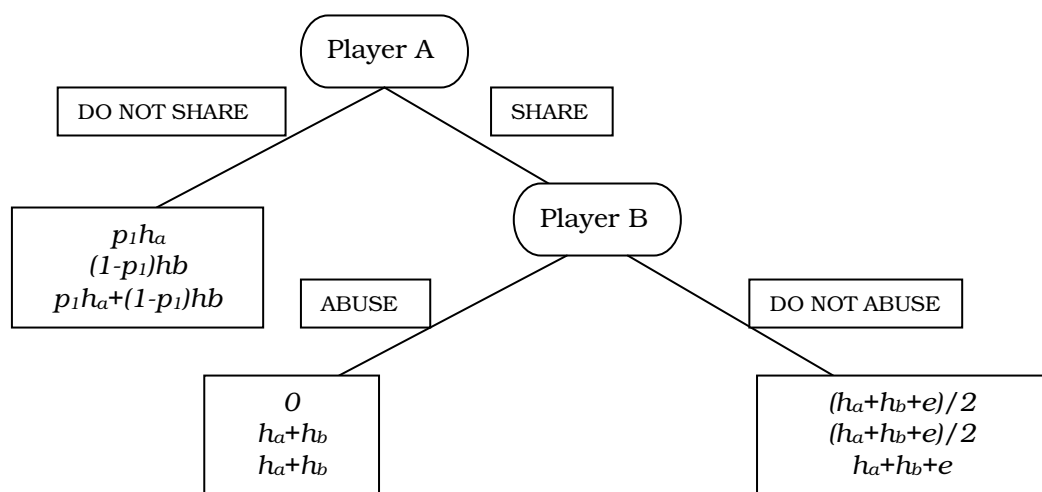
Proposition 6: in presence of imperfect information on the counterpart stand alone contribution, the non sharing solution yielding a suboptimal firm output is the SPNE of the uniperiodal full information game when the superadditive component is inferior to the sum of the trustee and trustor stand alone contributions to output. (The no abuse condition is unaltered with respect to the full information model but the superiority of the trustee stand alone contribution is no more required for the unicity of the (ns,..) equilibrium).

It is easy to check that as in the previous case, the no abuse condition is $e > h_a + h_b$ which is exactly the same as in the full information uniperiodal game.

The intuition for this first result is obvious. The no abuse condition compares two trustee's payoffs (conditional to the abuse and not abuse strategies respectively) under the assumption that the trustor has decided to share information. In both cases the trustee payoff includes the sum of the two players contributions and therefore the relative superiority of one or another stand alone contribution does not matter. The second part of the proposition depends on the fact that, under imperfect information on counterpart's skills, each player always attaches a nonzero probability to the fact that his skills may be superior to those of the other player²⁶.

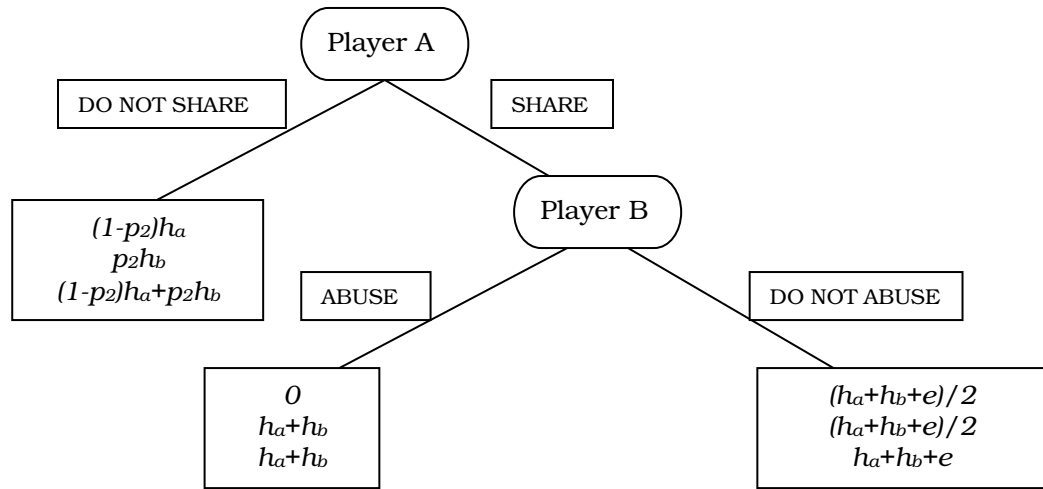
FIGURE 8 THE UNIPERIODAL FULL INFORMATION GAME UNDER IMPERFECT INFORMATION ON PLAYERS STAND ALONE CONTRIBUTIONS

Player A's point of view



²⁶ Hence, when player stand alone contribution is imperfectly known by the counterpart, the paradoxical case in which relational goods may induce a lower output when the no abuse condition is not met ($\text{Max}[h_a, h_b]$ instead of $h_a + h_b$) does not apply anymore, since this outcome occurs even without relational goods.

Player B's point of view



3 Basic Trust Game when Players do not own the Company

We now examine how equilibria change when we remove the assumption that players own the company. In this version of our model we show that the conception of firm activity as a series of trust games in which different tasks and information from various individuals are combined may be, under reasonable side assumptions, a sufficient condition for determining the relative inconvenience of single winner tournaments (or pay for performance schemes in presence of worker's taste for relational goods) even without considering the crowding out effect on intrinsic motivations and therefore, purely on extrinsic motivation grounds. We in fact show that: i) when the activity of a firm is conceived as a trust game and in presence of relational goods, a steeper pay for performance scheme increases the probability of non cooperative equilibria for given parametric values; ii) the cooperative equilibrium can never be attained with the introduction of a single winner tournament scheme, even without the presence of relational goods.

3.1 Pay for performance schemes

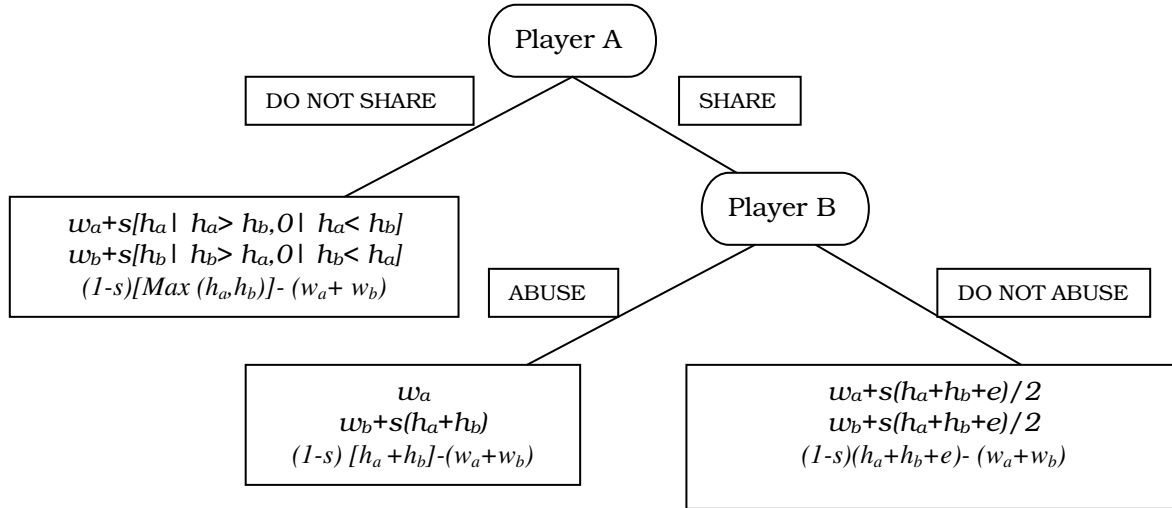
We start by considering a simple pay-for-performance structure, consisting of a fixed remuneration (w_a for player A, and w_b for player B) plus an additional share $s \in [0,1]$ of the employee's performance when it contributes to firm output. The inspection of the uniperiodal and infinitely repeated games under the new framework leads us to formulate the following proposition

Proposition 7. Individual pay for performance schemes are neutral in corporate trust games in which players do not own the firm, as they do not help to widen the parametric space of the cooperative equilibrium. In presence of relational goods pay for performance scheme triggers the switch from a cooperative (productively optimal) to a non cooperative (productively suboptimal) equilibrium. Hence, pay for performance schemes crowd out cooperation.

Under the pay for performance scheme framework the set of payoffs is

$\{w_a+s(h_a | h_a > h_b, 0 | h_a < h_b), w_b+s(h_b | h_b > h_a, 0 | h_b < h_a), \text{Max} (1-s)(h_a, h_b)- (w_a+ w_b) \}$
under the $(ns,.)$ pair of strategies, or $\{w_a, w_b+s(h_a+h_b), (1-s)(h_a+h_b)-(w_a+w_b)\}$ and
 $\{w_a+s(h_a+h_b+e)/2, w_b+s(h_a+h_b+e)/2, (1-s)(h_a+h_b+e)- w_a+w_b\}$ under the (s,a) and
 (s,na) pairs, respectively (see Figure 9).

FIGURE 9: THE UNIPERIODAL FULL INFORMATION GAME



It is easy to check in this case that the no abuse condition ($e > h_a+h_b$) corresponds to the no abuse condition of the full information game when players own the company. Let us evaluate the effect of relational goods in this framework. The payoff set under the $(ns,.)$, (s,a) and (s,na) pairs becomes respectively

$\{F+w_a+s(h_a | h_a > h_b, 0 | h_a < h_b), F+w_b+s(h_b | h_b > h_a, 0 | h_b < h_a), (1-s)\text{Max} (h_a, h_b)- w_a+w_b\}$

$\{w_a, w_b+s(h_a+h_b), h_a+h_b\}$

and

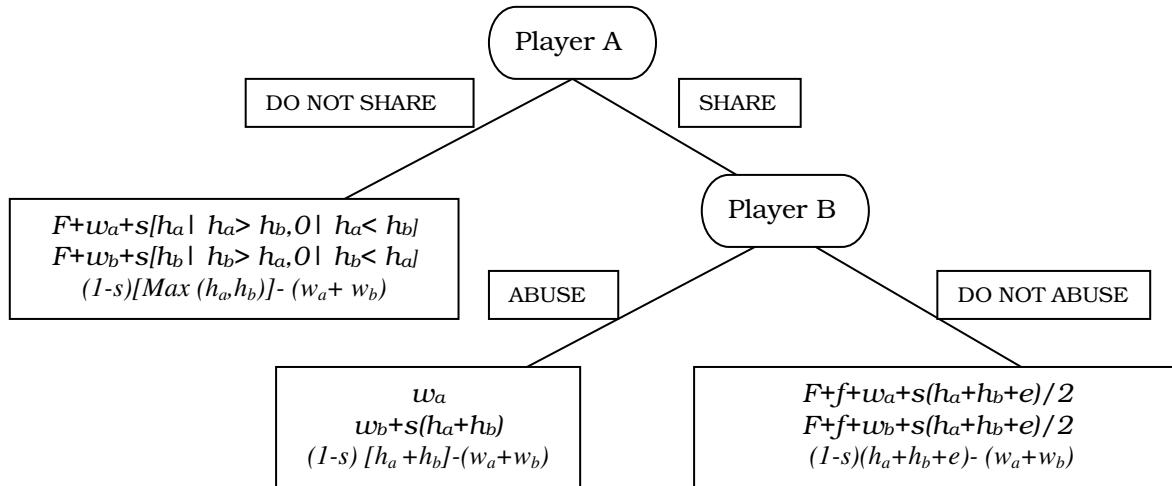
$\{F+f+w_a+s(h_a+h_b+e)/2, F+f+w_b+s(h_a+h_b+e)/2, (1-s)(h_a+h_b+e)- (w_a+w_b)\}$ (see Figure 10).

The no abuse condition in this case is $e > (h_a+h_b)- 2(F+f)/s$ and does not correspond anymore to the one of the full information game in which players own the company.

Note that, with $s=1$, we revert to the situation in which players own the company but, as far as s gets lower (and the pay for performance scheme gets flatter), the effect that preferences and enjoyment of relational goods have on making the no abuse condition easier to be met will be enhanced. This result show that, given the simple structure of corporate trust games, pay for performance schemes crowd out the quality of relationship and trust and provide a simple rationale to the puzzle evidenced, among others, by Baker, Jensen and Murphy (1998) on the relatively low use of individual pay for performance schemes in personnel management. It implies that a steeper reward scheme (s) may trigger the switch from the cooperative (s, na) to the non cooperative solutions of the game. The intuition is that (s) becomes the

relative price of the relational goods in terms of missed out-performance arising from the abuse strategy and this relative price rises as far as the share gets higher.

FIGURE 10: THE UNIPERIODAL FULL INFORMATION GAME WITH RELATIONAL GOODS AND PAY FOR PERFORMANCE SCHEMES



The inspection of this specific version of the game which is repeated in time confirms the main finding of the uniperiodal game and leads us to formulate the following proposition.

Proposition 8. In the two period and in the infinitely repeated trust game when players do not own the firm, steeper individual pay for performance schemes are neutral in absence of relational goods while they reduce the parametric space of cooperation in presence of relational goods .

Let start with the two period game without relational goods (Figure 11). The solution crucially depends again on the relative stand alone contributions. When we assume $h_a > h_b$ the "no abuse" condition is $[w_b + s(h_a + h_b + e)/2](1 + \delta) > w_b + s(h_a + h_b) + \delta w_b$ ²⁷. Consider that, here again, the no abuse condition does not depend on (s) and reduces to that of the two period model when the two players own the firm. Consider also that the no abuse condition requires that $\delta > 1 - e/(h_a + h_b)$, which may be easily satisfied under reasonable parametric assumptions.

Let suppose $h_b > h_a$. In this case, the no abuse condition is

$$[w_b + s(h_a + h_b + e)/2](1 + \delta) > w_b + s(h_a + h_b) + \delta(w_b + sh_b)$$

or, again, $e > (h_a + h_b)$, which corresponds to the single period full information game condition when the two players own the firm.

Consider now the presence of relational goods in the two period game (Figure 11).

Under $h_a > h_b$

the no abuse condition is $[w_b + s(h_a + h_b)] + \delta(w_b) < F + [f + w_b + s(h_a + h_b + e)/2](1 + \delta)$ yielding $\delta > [s(h_a + h_b - e) - 2F - 2f] / [2f + s(h_a + h_b + e)]$

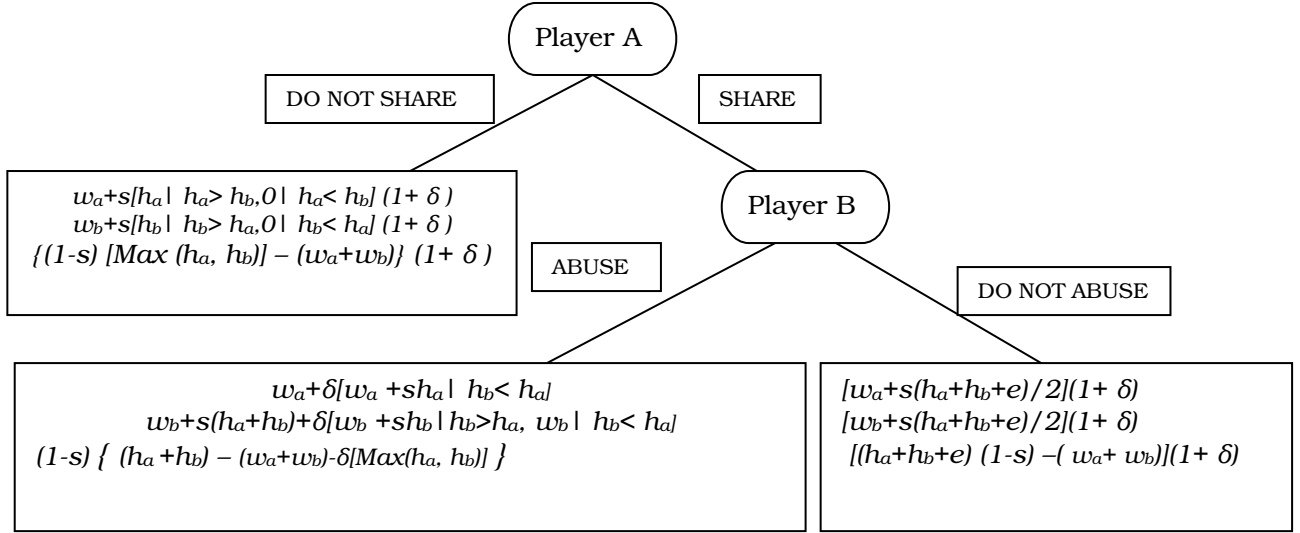
²⁷ Note that, with $s=1$ and $d=0$, we revert to the no abuse condition of the full information single period game of section 2, while, with $s=0$ and $d=0$, to a single period fixed wage model.

Under $h_a < h_b$ the no abuse condition is

$$[w_b + s(h_a + h_b)] + \delta (w_b + sh_b) < F + [f + w_b + s(h_a + h_b + e)/2](1 + \delta)$$

yielding $\delta > [s(h_a + h_b - e) - 2F - 2f] / [2f + s(h_a - h_b + e)]$

FIGURE 11: THE TWO PERIODS FULL INFORMATION TRUST GAME



Hence we may conclude that even in the two period game steeper pay for performance schemes are neutral in absence of relational goods, while they reduce the parametric space of cooperation in presence of relational goods.

In the same way in an infinitely repeated game in absence of relational goods, and, when $h_a > h_b$, we have $(1 - \tilde{\delta})[w_b + s(h_a + h_b)] + \tilde{\delta}(w_b) = w_b + s(h_a + h_b + e)/2$, yielding $\tilde{\delta} = 1/2 - e/2(h_a + h_b)$

Hence, a $\tilde{\delta}$ exists such that the Folk Theorem holds. Such value does not depend on the pay for performance scheme. When $h_a < h_b$ we have $(1 - \tilde{\delta})[w_b + s(h_a + h_b)] + \tilde{\delta}(w_b + sh_b) = w_b + s(h_a + h_b + e)/2$,

yielding $\tilde{\delta} = [h_a + h_b - e] / 2h_a$.

Let us now consider the infinitely repeated game with relational goods.

Under $h_a > h_b$ we get

$$(1 - \tilde{\delta})[w_b + s(h_a + h_b)] + \tilde{\delta}(w_b) = F + f + w_b + s(h_a + h_b + e)/2$$

Which yields $\tilde{\delta} = [h_a + h_b - e] / [2(h_a + h_b)] - (F + f) / [s(h_a + h_b)]$

When $h_a < h_b$ we have

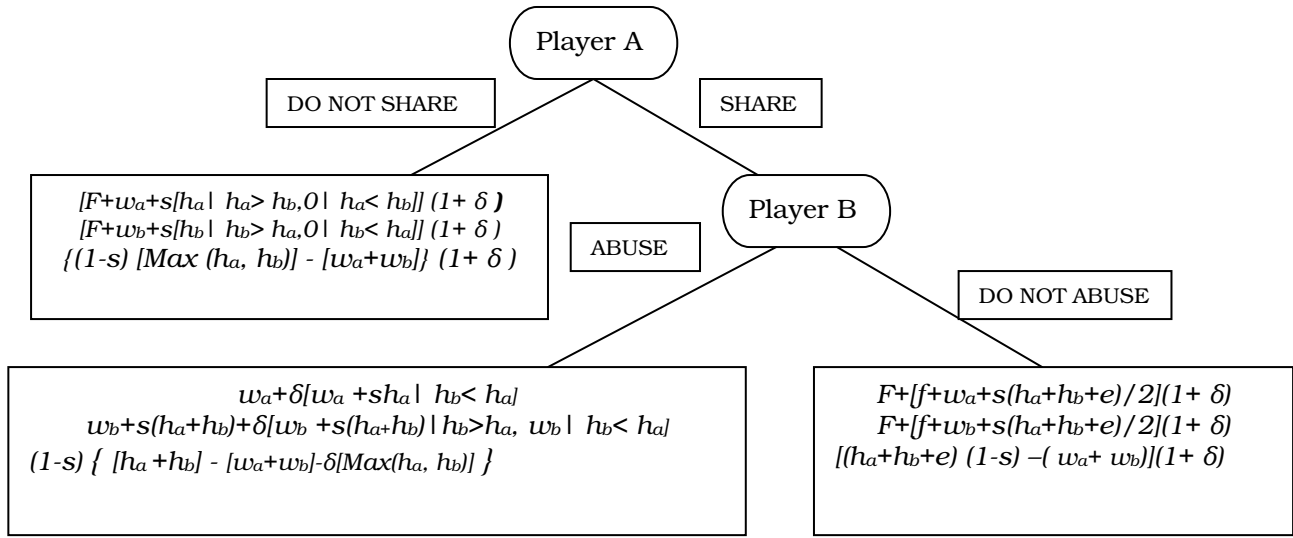
$$(1 - \tilde{\delta})[w_b + s(h_a + h_b)] + \tilde{\delta}(w_b + sh_b) = F + f + w_b + s(h_a + h_b + e)/2$$

yielding

$$\tilde{\delta} = (h_a + h_b - e) / 2h_a - (F + f) / sh_a$$

The two period result is confirmed.

FIGURE 12: THE TWO PERIODS FULL INFORMATION TRUST GAME WITH RELATIONAL GOODS



3.2 Firms with a vertical hierarchical structure

Remuneration schemes in firms with hierarchical structure also depend on the job levels and changes in employee's compensation may be obtained through a promotion. As pointed out by Baker, Jansen and Murphy (1998), promotions have two different purposes: i) they are a way to match individuals to the job for which they are best suited and ii) they provide incentives for lower level employees that evaluate the opportunity to increase their wage and job position obtaining a better one.²⁸

We now consider here a tournament promotion system, in which the best performer is promoted to the next higher career level. We assume that, if the (s,na) equilibrium applies, the winner is randomly selected and each of the two players has a 50 percent chance of getting the promotion. The introduction of this reward system in our corporate trust game leads us to formulate the following proposition.

Proposition 9. With an individual winner tournament structure the no abuse condition never applies.

Assume that player A and player B both work at the same hierarchy level at the beginning of the game. If the trustor (player A) decides not to share his information, the payoff set is:

$$\{w_a+(PR | h_a > h_b, 0 | h_b > h_a), w_b+(PR | h_b > h_a, 0 | h_a > h_b), Max(h_a, h_b)-w_a-w_b+PR \}$$

where PR is the promotion wage premium. If the trustor decides to share, we have to consider the (s,a) and (s,na) pairs of strategies. In the first case, the payoff set is: $\{w_a,$

²⁸ As in the case of pay-for-performance remuneration systems, disadvantages and advantages of promotion based incentive schemes are widely debated. Baker, Jansen and Murphy (1998) underline how incentives generated by promotion opportunities depend on the probability of promotions which, in turn, depends on the identity and expected horizon of the incumbent superior. Moreover, promotion incentives: i) do not work after promotion of a young employee with a long expected horizon in the job since such promotion decreases the probability of promotion and the incentive to work hard for co-workers; ii) are reduced for employees that already obtained it; iii) are absent for employees that fall short of the promotion standard; iv) generate problems in slowly growing or shrinking firms.

$w_b+PR, h_a + h_b - w_a+w_b+PR \}$ while, in the second case, the payoff set is $\{ (w_a+PR/2), (w_b+PR/2), [(h_a+h_b+e)] - (w_a+w_b+PR) \}$. Hence, the no-abuse condition is $(w_b+PR/2) > (w_b+PR)$ and can never hold. \square

The consequence of this result is that the trustor will never share his information when $h_a > h_b$, while he will be indifferent whether doing it or not when $h_b > h_a$. We can therefore conclude that, with a promotion based incentive system and an uniperiodal game, the cooperative solution will never be reached when $h_a > h_b$.

What happens if we allow for the existence of relational goods? In this case trustor taste for relational goods creates some room for the cooperative solution and may offset his propensity to abuse. If the trustor decides not to share a new idea the payoff set will be (respectively for the trustor, the trustee and for the firm):

$\{ [F+w_a+PR | h_a > h_b, 0 | h_b > h_a], [F+w_b+PR | h_b > h_a, 0 | h_a > h_b], \text{Max}(h_a, h_b) - w_b+w_b+PR \}$.

If the trustor decides to share the idea, the payoff set is $\{ w_a, w_b+PR, (h_a+h_b) - (w_b+w_b+PR) \}$

or $\{ w_a+PR/2+F+f, w_b+PR/2+F+f, h_a+h_b+e - w_b+w_b+PR \}$ under the (s,a) and (s,na) pairs of strategies respectively.

Hence, the no-abuse condition is $F+f > PR/2$.

The no abuse condition may therefore be met in presence of players taste for relational goods. This is because, even if an employee will not receive with certainty a promotion when he chooses to cooperate (the probability is 0.5), he may prefer to behave cooperatively if his taste for relational goods is strong enough.

6. Optimal personnel policies in the trust game corporation

In the light of the results presented above we may wonder what is the optimal policy for a “trust game corporation” which aims at maximising its output.

Under the scenario in which players do not own the firm, by considering the alternatives of i) a pay for performance scheme, ii) a single winner tournament system and iii) the investment in relational goods, the third option is definitely preferred by the firm under reasonable parametric conditions. Consider the scenario of the single period game and assume to be in those parametric conditions under which the SPNE of the game is the $(ns,.)$ equilibrium ($h_a > h_b, f=F=0$ and $e < h_a + h_b$) and the firm output loss is $h_a+h_b+e - \text{Max}(h_a, h_b)$. In such framework the firm will find it optimal to invest in relational goods if a production technology of relational good exists yielding the following cost function $C(f^*)=c^*$ such that $c^* < (h_a+h_b+e) - \text{Max}(h_a, h_b)$ (where $f^*=(h_a+h_b-e)/2-F$ is the threshold which triggers the switch from the non cooperative to the cooperative (s,na) equilibrium in the game illustrated in section 2.1).

In this perspective the trust game corporation is an environment in which a specific form of corporate socially responsible behaviour (the creation of a favorable environment for workers) has a positive effect on productive activity.

7. Conclusions

By modelling firm activity as a sequence of complex tasks having the basic features of trust games and requiring the contributions of different workers with nonoverlapping competencies we introduce a crucial feature of the corporate reality of our times. With this approach we explain some of the puzzles that standard firm theories cannot account for such as the lower than expected use of individual pay for performance schemes and single winner tournament schemes and the existence of corporate expenditure aimed at increasing relational goods among workers. The corporate trust game model provides several interesting insights. First, it identifies a microeconomic nexus between social capital and creation of economic value at the firm level. Second, it explains why individual pay for performance schemes may, under reasonable parametric assumptions, crowd out social capital and cooperation justifying their lower than expected application in the reality. Third, it provides an explanation on why single winner tournament schemes are seldom implemented by corporations showing how they crowd out information sharing and lead to suboptimal output even without taking into account workers intrinsic motivations. Fourth, it shows how the taste for relational goods significantly affects workers cooperation which, in turn, positively affects firm productivity.

As expected, our results are much stronger in single period than in repeated games but also in the latter our conclusions hold for relevant parametric spaces and, in those cases in which cooperative equilibria may be attained on the basis of the Folk Theorem, we show that such equilibria are not renegotiation proof.

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Appendix

The relevance of relational goods in the workplace

We extract a sample of 82 countries from the World Value Survey and estimate the following ordered logit model to evaluate the impact of different determinants of self declared happiness²⁹

$$Happy_i = \alpha_0 + \alpha_1 Eqincome + \alpha_2 [Eqincome]^2 + \alpha_3 Male + \alpha_4 Mideduc + \alpha_5 Upeduc + \alpha_6 [Age]^2 + \alpha_7 Unempl + \alpha_8 Selfempl + \sum_{k=1}^5 \vartheta_k Timeforrel_k + \sum_{j=1}^9 \beta_j Drelincome_j + \sum_{i=1}^n \gamma_i Marstatus_i + \sum_{l=1}^m \delta_l Dcountry_l$$

The dependent variable ($Happy_i$) is built from the answers to the following question - *All considered you would say that you are: i) very happy; ii) pretty happy; iii) not too happy; iv) not at all happy*- by giving descending values (from 3 to zero) to answers i) to iv).

Eqincome is a continuous measure of (income class median) equivalent income expressed in year 2000 US dollar purchasing power parities in levels and in squares. *Male* is a dummy which takes the value of one for men and zero otherwise. To measure the impact of education two dummies are included for those with high school diploma (*Mideduc*) and another for those with university degree *Upeduc*, following the choice of Alesina et al. (2001). *Age* is the respondent age (introduced in levels and in squares) to take into account nonlinearities in its relationship with happiness (see, among others, Alesina et al., 2001 and Frey and Stutzer, 2000), the professional status is measured by two different job conditions variables *Unempl* and *Selfempl* recording unemployed and selfemployed individuals. *Timeforrel* is a vector including a series of variables measuring the time spent: i) with friends (*timefriends*); ii) with working colleagues outside the workplace (*timejobfriends*); iii) with the family (*timefamily*) iii) in the worship place (parish, mosque, synagogue) with friends sharing the same religious confession (*timerelig*); iv) in clubs or volunteering (sport, culture, etc.) association (*timesportfriend*). For each of these questions the answers can be: i) every week; ii) once or twice a month; iii) a few times per year; iv) never. The difference among intensity modes is not continuous and we rank each of the answers on a scale with values which are increasing in the time spent for relationship (i.e., 3 if the answer is every week and 0 if it is never). The relative income effect is calculated by introducing nine dummies (*Drelincome*) measuring individual position in the relevant domestic income decile. The four marital status (*Marstatus*) variables (Single, Married, Divorced and Separated) are all dummies taking the value of one if

²⁹ Reliability of self-declared happiness data is supported by Alesina et al. (2001) when they recall that psychologists, whose core professional activity is studying well being, extensively use these data.

Alesina et al. (2001) also observe that there exists a well documented evidence of a positive correlation between self declared happiness and healthy physical reactions such as smiling attitudes (Pavot 1991, Ekman et al., 1990), heart rate and blood pressure responses to stress (Shedler, Mayman and Manis, 1993), electroencephalogram measures of prefrontal brain activity (Sutton and Davidson, 1997) and of a negative correlation between the same variable and the attitude to commit suicide (Koivumaa-Honkanen et al., 2001).

the individual has the given status and zero otherwise. Country dummies are also included. The table reports coefficient magnitude and significance of the *timeforrel* variables in sub-sample estimates (males, females, high income OECD countries, low income OECD countries, European Union). showing the significance of relational time spent with job colleagues on individual happiness.

Table A1. The effect of relational time on happiness

Comp. Averleisuredue	Male	Female	Hi- oecd	NoHi- oecd	European Union
<i>Timefriends</i>	0.052** [0.023]	0.053** [0.021]	0.162** [0.048]	0.042** [0.016]	0.056 [0.113]
<i>Timejobfriends</i>	0.047** [0.016]	-0.009 [0.016]	0.07** [0.032]	0.013 [0.012]	0.169** [0.077]
<i>Timefamily</i>	0.055** [0.022]	0.055 [0.022]	0.08** [0.039]	0.051** [0.017]	0.055 [0.113]
<i>Timerelig</i>	0.138** [0.017]	0.113** [0.016]	0.155** [0.031]	0.107** [0.012]	0.135 [0.078]
<i>Timesportfriends</i>	0.065** [0.017]	0.058 [0.019]	0.088** [0.03]	0.057** [0.014]	0.14 [0.078]